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# UNITED STATES DEPARTMENT OF AGRICULTURE

In Cooperation with the
Louisiana Agricultural Experiment Station

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# SOME NEW VARIETIES OF RICE.


By CHARLES E. CHAMBLISS, *Agronomist in Charge of Rice Investigations, Office of Cereal Investigations, Bureau of Plant Industry,* and J. MITCHELL JENKINS, *Superintendent, Rice Experiment Station, Crowley, La.,* and *Assistant Agronomist, Office of Cereal Investigations, Bureau of Plant Industry.*


CONTENTS.


| | Page. |
|---|---|
| Introduction | 1 |
| Conditions under which the rice varieties described were grown | 1 |
| Description of the rice plant | 3 |
| Descriptions of the varieties | 5 |
| Fortuna | 5 |
| Acadia | 6 |
| Delitus | 7 |
| Tokalon | 8 |
| Descriptions of the varieties—Contd. | |
| Evangeline | 9 |
| Vintula | 10 |
| Salvo | 11 |
| Honduras | 11 |
| Wataribune | 12 |
| Blue Rose | 13 |
| Shinriki | 14 |
| Comparison of varieties | 15 |


## INTRODUCTION.

This bulletin includes a description of the rice plant and a botanical and agronomic description of seven new varieties that have been developed in the course of cooperative experiments at the Rice Experiment Station, Crowley, La., and of four varieties now widely grown in this country. The agronomic performance and adaptation of each variety, including a full description of the conditions under which the experiments were conducted, are discussed in detail. The commercial value of the milled rice of the new varieties from a culinary standpoint is indicated.

## CONDITIONS UNDER WHICH THE RICE VARIETIES DESCRIBED WERE GROWN.

The seven new varieties of rice herein described were developed from pure-line selections at the Rice Experiment Station, Crowley, La., and grown under the same conditions as the four long-established varieties which also are described in this bulletin.

The station is operated by the Louisiana Agricultural Experiment Station in cooperation with the Office of Cereal Investigations of the Bureau of Plant Industry. It is located 1 mile west of Crowley and is within a few miles of the eastern border of the

prairie region of southwestern Louisiana, where rice is the important money crop.

The soil of the experiment station is the Crowley silt loam. It is the typical rice soil of the prairies in this section of the State and contains approximately 4 per cent of very fine sand, 69 per cent of silt, and 23 per cent of clay. It is of a brown or ash-gray color and rather compact in structure, with a tendency to puddle when plowed in a wet state. The subsoil, which lies at an average depth of 16 inches, is a mottled blue and yellow clay which is so impervious that there is no vertical seepage through it. Levees that contain much of this clay are practically water-tight.

The varietal experiments were made on tenth-acre plats, measuring 2 rods wide and 8 rods long. They were arranged side by side in series, each plat being separated from that on either side by a 5-foot alley. The series were inclosed by levees in which were located gates that could be operated to discharge water into or from the plats whenever it was desired. The irrigation water was obtained from a deep well and conveyed to the series through ditches. These ditches also served for drainage purposes.

The land used in testing these varieties was plowed in late autumn or early winter to the depth of 5 to 7 inches and well drained during the winter. Under these conditions, the necessary field operations for making a good seed bed in spring consisted usually of one double disking and one harrowing before seeding. A float always was used after disking. As a rule, this preparation left the surface soil loose and finely divided to a depth of several inches and made a seed bed which retained moisture so well that irrigation was seldom used to promote germination.

The varieties were grown each year on land that grew soy beans in the previous year. The beans were sown at the rate of 30 pounds per acre in rows 4½ feet apart and were cultivated. The seed was harvested and the stems and leaves plowed under. The vegetable matter thus added to the soil greatly improved its physical condition. The frequent cultivations of the soy beans served to control weeds, especially red rice. By the use of this legume, plant food in the form of nitrogen was stored in the soil. No commercial fertilizers were applied to the plats.

The rice seed was sown with a drill to a depth of 2 inches during the first week of May at the rate of 80 pounds per acre.

The irrigation water was applied to the plats approximately 30 days after the rice plants emerged. At this time the average height of the plants of the different varieties ranged from 8 to 13 inches. Throughout the remainder of the growing season an average depth of 5 inches of water was maintained. Fresh water was admitted to the plats when needed to equal the losses from seepage, evaporation, and transpiration.

The plats were drained when the panicles were well turned down. The grain was harvested with a hand hook and put in large shocks, where it remained for weeks before it was thrashed. The shocks were strongly built to withstand the wind and so capped that the grain was protected from rain as well as sun.

## DESCRIPTION OF THE RICE PLANT.

Most of the varieties of rice cultivated in this country belong to the species *Oryza sativa* L. They are annual grasses with fibrous roots extending outward and downward in all directions from the crown, which is located about 1½ inches above the lower end of the culm. The distribution of the roots usually is outward and very near the surface of the soil. Under normal conditions most of the roots do not extend to a greater depth than 3 to 5 inches. When grown without irrigation and before the irrigation water is applied when irrigated, the roots penetrate the soil more deeply than when the soil is submerged. Adventitious roots (Fig. 1, *B*) arise from the first, second, and third nodes. They are more conspicuous in some varieties than in others and often are produced under irrigation when the water level is suddenly lowered or raised.

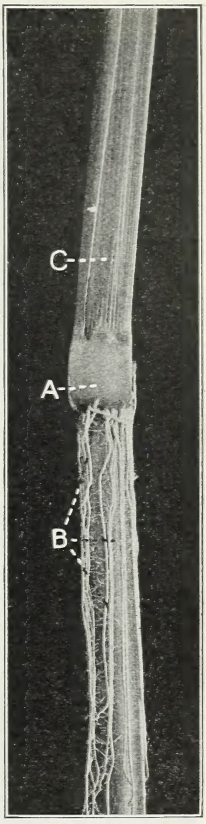



FIG. 1.—A part of the two lower internodes of a culm of rice, showing sheath node (*A*), adventitious roots (*B*), and leaf sheath (*C*). The leaf sheath has been removed to expose the adventitious roots. (Natural size.)

The culms of the rice plant are erect, cylindrical, and hollow, with solid nodes. They vary in length from approximately 2 to 6 feet, depending largely upon the variety, but to a certain extent upon the soil and probably other factors. The number of culms to a plant varies greatly, usually ranging from 3 to 12. The wall of the culm in the lower internodes is thick. That of the peduncle, below the panicle, is much thinner but still strong. In color the internodes are light green to yellowish green. They are sometimes streaked with brown or purple. The nodes usually are darker green or brown.

The leaves vary in number from five to eight. As a rule, there are six, including two basal leaves, one of which may wither and become detached before the plant matures. The sheath nodes, or swollen bases of the leaf sheaths (Fig. 1, *A*), are conspicuous and usually a light green. The sheaths (Fig. 1, *C*), which are open in part, are much shorter than the blades. They are green and occasionally marked with purple on their inner surface near the base. The auricles are hairy and prominent (Fig. 2, *B*), and may be light yellow or green, cartilaginous or membranous. The ligules (Fig. 2, *A*) are prominent, light yellow or sometimes light green, acute or obtuse, and often split for their entire length. The blades (Fig. 2, *D*) vary in width from a little less than half an inch to 1 inch and in length from 16 to 20 inches. They are erect or ascending, usually the latter, and prominently veined. Their surfaces are glabrous or puberulent, though sometimes rough, particularly toward the apex. The apex is acute or acuminate. Narrow blades are characteristic of the short-grain varieties of rice.

The inflorescence is a panicle, the main axis of which is smooth, except toward the apex, where it often is slightly rough. The branches are arranged singly or in pairs and have a somewhat rough surface. The panicle is compact and drooping (Fig. 3), though sometimes it is erect and open.

The spikelets (Pl. I, *A*) are 1-flowered and strongly compressed laterally. There are two small lance-shaped glumes (Pl. I, *A* 1). These are keeled or flat and are about one-third as long as the lemma and palea. They often have a sharp tooth on one or both of their margins below the apex. In some varieties the glumes are much longer and very conspicuous. The lemma (Pl. I, *A*, 2) and palea (Pl. I, *A*, 3) are firm, chartaceous, usually pubescent, and strongly compressed laterally. They are of the same length and keeled. The lemma has five nerves and often is awned. Its margins are curved inward, clasping the outcurved margins of the palea. The palea has two nerves, which are located very near the margins. The lateral and central nerves of the lemma and the two nerves of the palea sometimes are excurrent as short conical teeth (Pl. I, *B*, 4), which are often conspicuous by their color.

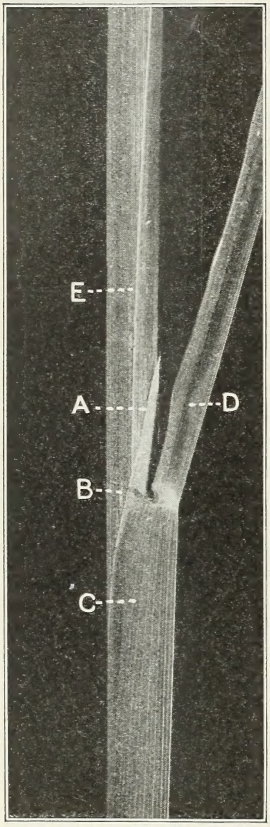



FIG. 2.—A part of two internodes of a culm of rice, showing ligule (*A*), auricle (*B*), leaf sheaths (*C*) and (*E*), and leaf blade (*D*). (Natural size.)

The flower of the rice plant is inclosed within the lemma and palea. It consists of six stamens and a comparatively long ovary surmounted by two styles united at their bases and each bearing a plumose stigma. There also are two lodicules.

In the popular sense, the seed (Pl. I, *B*) of the rice plant consists of the glumes, lemma, palea, and kernel. Commercially, the terms rough rice and paddy are used to designate this thrashed grain when marketed for milling. The lemma and palea constitute the hull (Pl. I, *B*, 2 and 3), which incloses the kernel.

The kernel (Pl. I, *C*) or caryopsis is completely inclosed by the lemma and palea. It may be oblong, elliptical, or almost ovoid in shape. Its width (lateral diameter) is never greater than its thickness (dorsiventral diameter). The surface of the kernel is marked on each side by two longitudinal ridges and one deep groove (Pl. I, *C*, 5). The grooves lie near the ventral margin and are conspicuous. The embryo (Pl. I, *C*, 1) is located on the dorsal surface and lies obliquely to the long axis of the kernel. In the short-grain varieties it is approximately one-third as long as the kernel; in the long-grain rices one-fourth as long. The endosperm is white, hard, and flinty, though sometimes soft and brittle. It is translucent, but often has a white opaque area (Pl. I, *C*, 2) within. This may be located

in the center of the endosperm, extending outward toward the dorsal surface, or it may be located on the dorsal surface and extend inward toward the center. In many varieties the opaque area, when present, is located in the middle of the dorsal surface. It is commonly referred to as the "white belly" of the kernel instead of the "white back," which it really is.

The endosperm is opaque in the glutinous varieties of rice. These varieties are not grown in the United States and only on a comparatively small acreage in the Orient, where they are used mainly for confectionery purposes.

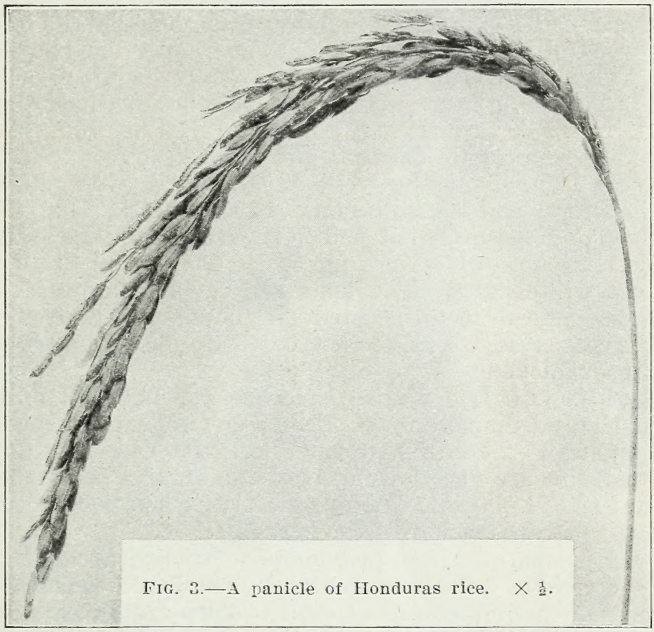


FIG. 3.—A panicle of Honduras rice. × ½.

## DESCRIPTIONS OF THE VARIETIES.

Eleven varieties of rice are described in the following pages. Seven of these, Fortuna, Acadia, Delitus, Tokalon, Evangeline, Vintula, and Salvo, are new varieties developed from pure-line selections, and four, Honduras, Wataribune, Blue Rose, and Shinriki, are long-established commercial varieties.

### FORTUNA.

The Fortuna variety is a pure-line selection from the Pa Chiam variety, which was obtained in 1905 by the United States Department of Agriculture from the Department of Agriculture of Formosa.

The selection was made at the Rice Experiment Station, Crowley, La., by the writers in 1911. The name "Fortuna" is derived from the Latin, meaning fortune, and was applied to this selection in 1917. It

was increased from nursery to plat experiments in 1915. The plat yields are given in Table 2. The variety was distributed in southwestern Louisiana for commercial growing in 1918. Enough seed of Fortuna (C. I. No. 1344) was grown in 1921 to sow approximately 100,000 acres in 1922.

The stout green culms of the Fortuna variety are striped with purple and usually number five to the plant. Their average height, including the panicles, is 51 inches. The nodes are brown, marked on their lower margin with green. The sheath nodes are light green and marked on their upper margin with purple. The outer surface of the leaf sheaths is green, streaked with purple, and their inner surface is purple, especially toward the base. The auricles are membranous and persistent. The ligules average five-eighths of an inch in length. The leaf blades are broad, averaging five-eighths of an inch in width. The panicles have an average length of 11½ inches, and each bears on an average 187 seeds. Before maturity the glumes are dark purplish brown, and the distal end of the spikelets is purple. The stigmas are dark purple.

The seeds (kernel plus hull; Pl. I, *D* and *E*) average 10.1 millimeters in length and 3.1 millimeters in thickness. The glumes are light brown and distinctly notched on the margins. The hull (lemma and palea) is pale yellow, medium in thickness, and thinly covered with short white hairs. The apex of the hull terminates in two dark-brown conical teeth, located on the meson, and unequal in length. The conical lateral teeth usually are absent and when present are inconspicuous.

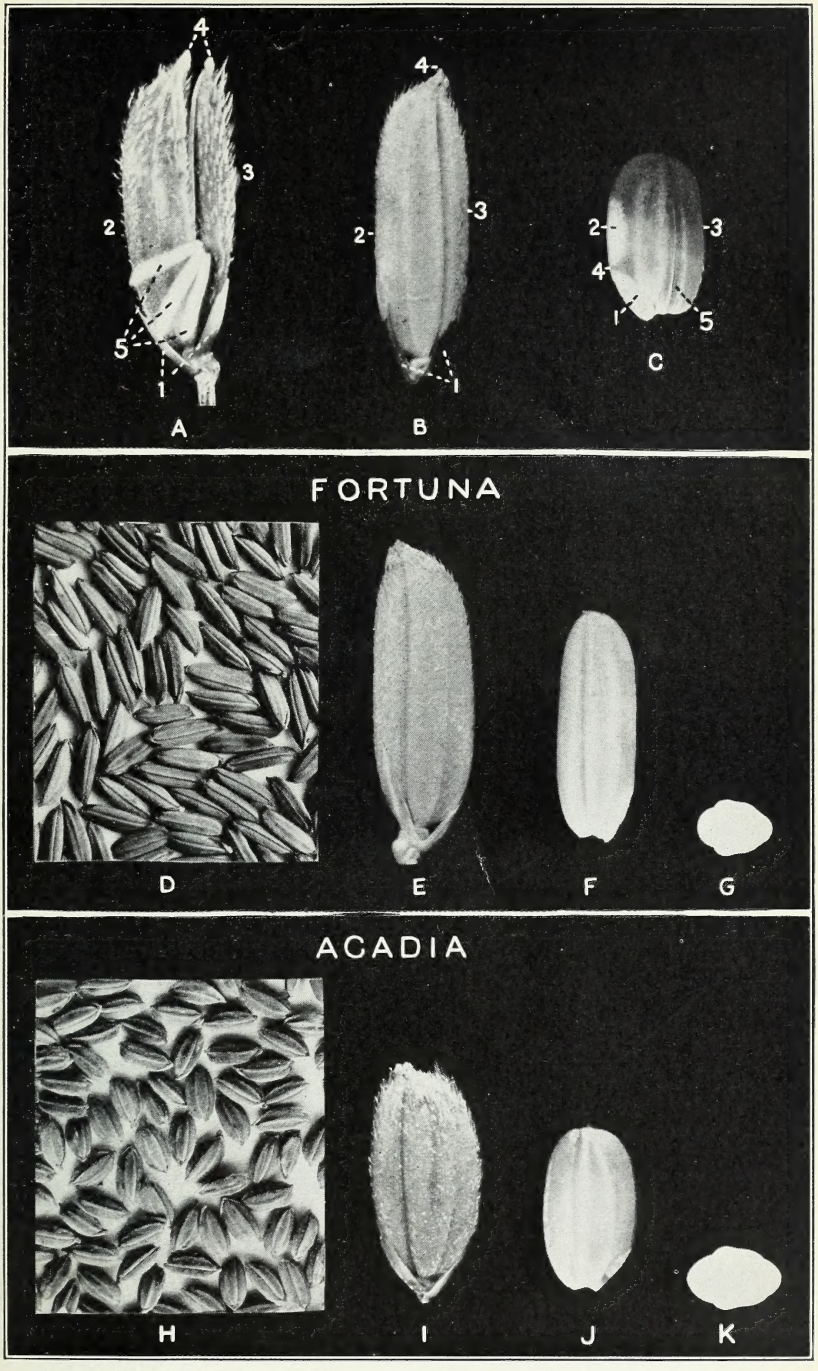
The kernels (Pl. I, *F* and *G*) average in length 7.7 millimeters, in width (lateral diameter) 1.8 millimeters, and in thickness (dorsiventral diameter) 2.5 millimeters. Viewed laterally, the dorsal and ventral margins are unequally convex, the ventral being the less so. The distal end is obtuse. The opaque area when present is narrow and located near the center of the kernel.

This variety matures in approximately 142 days and has produced an average yield of 2,530 pounds of paddy and 2,210 pounds of straw per acre. On the lighter soil of southwestern Louisiana it produced 2,199 pounds of paddy per acre. Acre yields of 2,775 pounds of paddy have been obtained from it on old prairie land which had been rested and closely pastured for two years. On new land in the Mississippi River section of Louisiana near Carville this variety has produced 5,366 pounds of excellent grain per acre. It produces good yields on poor soil. When grown on very rich soil it shows a tendency to lodge. Its grain is likely to shatter if harvest is delayed too long after maturity.

### ACADIA.

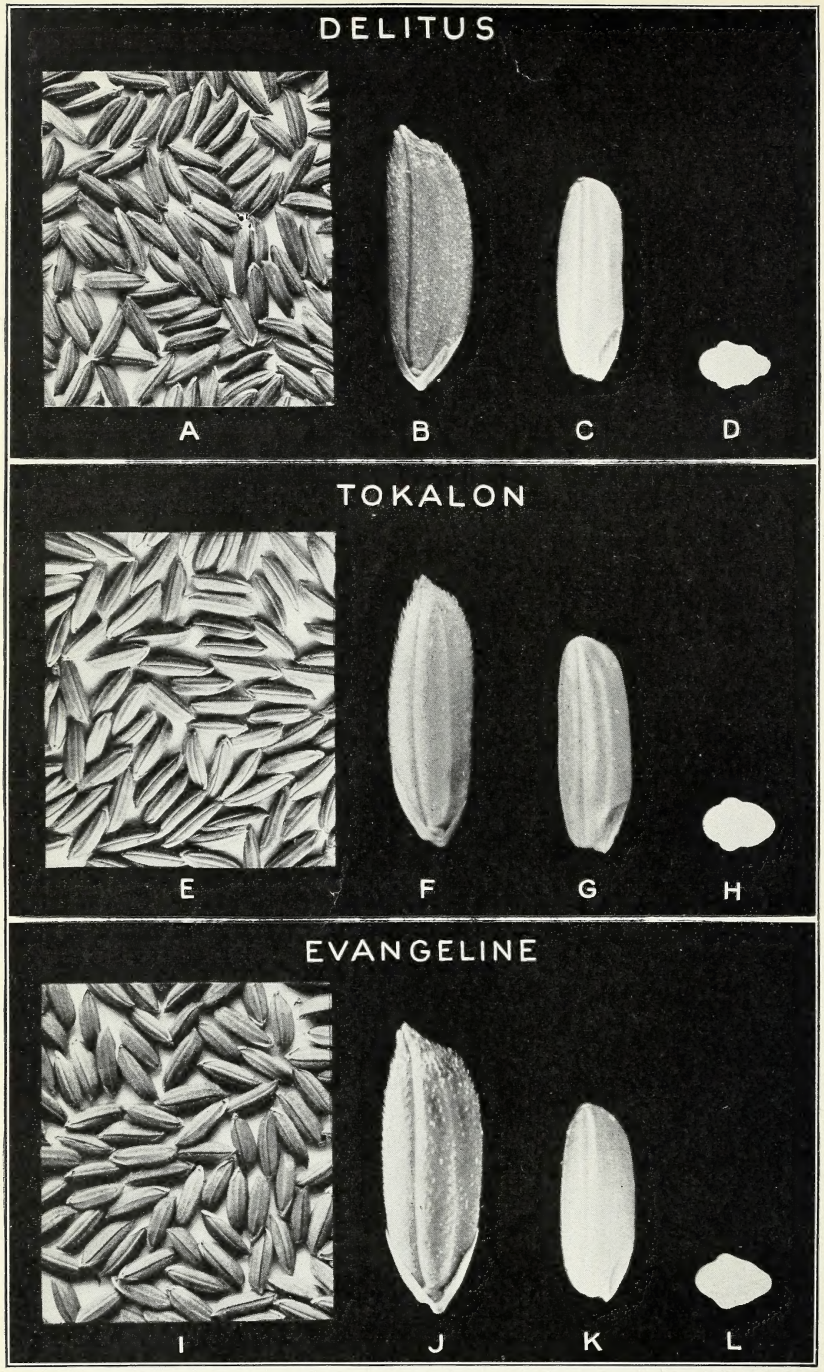
The Acadia variety is a pure-line selection from the Omachi variety, which was imported from Japan in 1910 by a rice farmer of Crowley, La.

This selection was made at the Rice Experiment Station, Crowley, La., by the writers in 1911. The name Acadia is the name of the parish in which the station is located and was applied to this selection in 1917. The selection was increased from nursery to plat experiments in 1916. The plat yields are given in Table 2. The variety




SPIKELET, SEEDS, AND KERNELS OF RICE.

*A*, Spikelet; *B*, seed; *C*, kernel. Fortuna and Acadia varieties: *D*, *E*, *H*, *I*, Seeds; *F*, *J*, kernels; *G*, *K*, transverse sections of kernels. (Figures *D* and *H*, natural size; all others, × 4.)




SEEDS AND KERNELS OF RICE OF THE DELITUS, TOKALON, AND EVANGELINE VARIETIES.

*A*, *B*, *E*, *F*, *I*, *J*, Seeds; *C*, *G*, *K*, kernels; *D*, *H*, *L*, transverse sections of kernels. (Figures *A*, *E*, and *I*, natural size; all others, × 4.)

was distributed in southwestern Louisiana for commercial growing in 1918. Enough seed of Acadia (C. I. No. 1988) was grown in 1921 to sow at least 40,000 acres in 1922.

The slender culms of the Acadia variety are light green and usually number 10 to the plant. The average height, including the panicle, is 50 inches. The culm and sheath nodes are dark green. The auricles are deciduous. The ligules average half an inch in length. The leaf blades are narrow, averaging three-eighths of an inch in width. The panicles have an average length of 9 inches, and each bears on an average 132 seeds.

The seeds (Pl. I, *H* and *I*) average 7.2 millimeters in length and 3.7 millimeters in thickness. The glumes are very pale yellow and have entire margins. The hull loosely incloses the kernel and is of medium thickness and yellow. Its surface has a burlaplike appearance and is thinly covered with white hairs, which are long and conspicuous toward the apex. The apex of the hull terminates in four conical yellow teeth. The two that are prominent are located on the meson and are of equal length. The other two are lateral, very short, and inconspicuous.

The kernels (Pl. I, *J* and *K*) average in length 5.7 millimeters, in width 2.1 millimeters, and in thickness 3.2 millimeters. Viewed laterally, the dorsal and ventral margins are equally convex, and their distal end is broadly obtuse. The opaque area, when present, usually is small and located on the dorsal margin.

This variety matures in approximately 139 days. It produced an average yield of 2,884 pounds of paddy and 2,020 pounds of straw per acre. It has produced 4,702 pounds of paddy per acre on old rice land in the Mississippi River section of Louisiana and as much as 5,155 pounds on new land in the same locality. On the prairies of southwestern Louisiana yields of 3,800 pounds per acre have been obtained.

### DELITUS.

The Delitus variety is a pure-line selection from the Bertone variety, which was obtained by the United States Department of Agriculture in 1904 from Vilmorin, Andrieux & Co., Paris, France. The selection was made at the Rice Experiment Station, Crowley, La., by the writers in 1911. The name Delitus is an abbreviation of the Latin word meaning delicate and was chosen also on account of its similarity in sound to the words "delight us." It was applied to this selection in 1917. This selection was increased from nursery to plat experiments in 1914. The plat yields are given in Table 2. The variety was distributed in southwestern Louisiana for commercial growing in 1918. The acreage of Delitus (C. I. No. 1206) is small, as at present it is grown only for home use.

The culms of the Delitus variety are medium in size, brown, slightly flexed at the fourth node, and usually number seven to the plant. Their average height, including the panicles, is 53 inches. The nodes are dark brown and the sheath nodes light green. The inner surface of the lower part of the sheaths and the outer surface of the sheaths near the base are purple. The auricles are not prominent, but are persistent. The ligules average five-eighths of an inch in length. The leaf blades are broad, averaging five-eighths of an inch in width. The panicles have an average length of

9¾ inches, and each bears on an average 122 seeds. Before maturity the glumes and the distal end of the spikelets are purplish brown. The stigmas are tinged with purple.

The seeds (Pl. II, *A* and *B*) average 8.9 millimeters in length and 2.9 millimeters in thickness. The glumes are light brown and plainly notched on the margins. The thin hull, which loosely incloses the kernel, is light brown and sparingly covered with short white hairs, which are more numerous toward the apex. The apex of the hull terminates in two conical dark-brown teeth, located on the meson, which are unequal in length and slightly bent ventrad. The conical lateral teeth usually are absent and when present are very inconspicuous.

The kernels (Pl. II, *C* and *D*) average in length 7.1 millimeters, in width 1.6 millimeters, and in thickness 2.4 millimeters. Viewed laterally, the dorsal and ventral margins are unequally convex, the ventral being the less so. Their distal end is more or less obtuse. The opaque area is seldom present.

This variety matures in approximately 131 days and produces an average yield of 1,862 pounds of paddy and 1,350 pounds of straw per acre. Although its yielding capacity is not large, this rice is worthy of cultivation on account of the distinct flavor of its kernels, resembling that of pop corn. This character is not possessed by any other rice except Salvo grown in the United States.

### TOKALON.

The Tokalon variety is a pure-line selection from the Carangiang variety, which was obtained in 1904 by the United States Department of Agriculture from the rice exhibit of the Philippine Islands at the Louisiana Purchase Exposition.

The selection was made at the Rice Experiment Station, Crowley, La., by the writers in 1911. The name Tokalon is derived from the Greek, meaning the beautiful, and was applied to this variety in 1917. The selection was increased from nursery to plat experiments in 1915. The plat yields are given in Table 2. The variety was distributed in southwestern Louisiana for commercial growing in 1918. Enough seed of Tokalon (C. I. No. 51) was grown in 1921 to sow 6,000 acres in 1922.

The thick culms of the Tokalon variety are green and usually number six to the plant. Their average height, including the panicles, is 50 inches. The culm nodes are brown; the sheath nodes green. The inner surface of the leaf sheaths is light purple. The auricles are deciduous. The ligules average five-eighths of an inch in length. The leaf blades are broad, measuring five-eighths of an inch in width. The panicles have an average length of 10⅓ inches, and each bears on an average 152 seeds. Before maturity the distal end of the spikelets is reddish brown.

The seeds (Pl. II, *E* and *F*) average 9.3 millimeters in length and 2.9 millimeters in thickness. The glumes are pale yellow and have smooth margins. The hull firmly incloses the kernel. It is light yellow, medium in thickness, and thinly covered with short white hairs. The apex of the hull terminates in four conical brown teeth. The two located on the meson are prominent, unequal in length, and bent ventrad. The other two are lateral and very short.

The kernels (Pl. II, *G* and *H*) average in length 7.5 millimeters, in width 1.8 millimeters, and in thickness 2.4 millimeters. Viewed laterally, the dorsal and ventral margins are equally convex, and their distal end is obtuse. The opaque area when present is narrow and located near the center of the kernel.

This variety matures in approximately 143 days and has produced an average acre yield of 2,443 pounds of paddy and 2,310 pounds of straw. It seems well adapted to southwestern Louisiana, producing larger yields on the clay soils of the prairies than on the alluvial Delta lands. This rice shows a strong tendency to shatter when it matures in late autumn. This loss may be prevented by early seeding. Production on poor soils is greater from this variety than from any of the varieties now grown on the Coastal Plain in the Louisiana-Texas rice belt. On account of the white thin bran of the kernel it might be used to meet the increasing demand for "brown" or "natural" rice.

### EVANGELINE.

The Evangeline is a pure-line selection from an unnamed variety which was obtained by the United States Department of Agriculture in 1904 from the rice exhibit of Guatemala at the Louisiana Purchase Exposition. The selection was made at the Rice Experiment Station, Crowley, La., by the writers in 1911. The name Evangeline is taken from Longfellow's poem of the same name and was applied to this selection in 1917. It was increased from nursery to plat experiments in 1914. The plat yields are given in Table 2. The variety was distributed in southwestern Louisiana for commercial growing in 1918. No accurate estimate of the acreage of Evangeline (C. I. No. 1162) can be made at present. It probably will be grown more extensively on the Delta lands than in the prairie sections of Louisiana.

The stout green culms of the Evangeline variety are slightly flexed at the second node and usually number six to the plant. Their average height, including the panicles, is 45 inches. The culm nodes are dark green; sheath nodes light green. The auricles are prominent and persistent. The ligules average three-fourths of an inch in length. The leaf blades are broad, averaging three-fourths of an inch in width. The panicles have an average length of $8\frac{1}{2}$ inches, and each bears on an average 140 seeds.

The seeds (Pl. II, *I* and *J*) average 9 millimeters in length and 3.1 millimeters in thickness. The glumes are pale yellow and have smooth margins. The hull tightly incloses the kernel, is light yellow, medium in thickness, and thinly covered with very short white hairs. The apex of the hull terminates in two conical light-yellow teeth. These are located on the meson, are unequal in length, and distinctly bent ventrad. The conical lateral teeth are usually absent and when present are inconspicuous.

The kernels (Pl. II, *K* and *L*) average in length 7 millimeters, in width 1.8 millimeters, and in thickness 2.6 millimeters. Viewed laterally, the dorsal and ventral margins are equally convex, and their distal end is obtuse. The opaque area often extends from the dorsal margin to the center.

This variety matures in approximately 122 days and has produced an average acre yield of 2,027 pounds of paddy and 1,191 pounds of straw. On the ordinary prairie lands of southwestern Louisiana it produced 1,850 pounds of paddy per acre. It grows on very rich land without showing a tendency to lodge and has produced acre yields under these conditions as high as 3,420 pounds of grain. The production of 2,500 pounds of paddy per acre has been reported from the Delta lands of the Mississippi River section of Louisiana.

### VINTULA.

The Vintula variety is a pure-line selection from an unnamed variety from Ceylon which was obtained by the United States Department of Agriculture from the Botanical Gardens, Georgetown, British Guiana, where it had been grown experimentally for several years.

The selection was made at the Rice Experiment Station, Crowley, La., by the writers in 1911. The name Vintula, composed of the first four letters of Vinton, the name of a town in southwestern Louisiana, and the abbreviation of Louisiana, with the letter u inserted for euphony, was applied to this selection in 1917. This selection was increased from nursery to plat experiments in 1914. The plat yields are given in Table 2. The variety was distributed in southwestern Louisiana for commercial growing in 1918. Enough seed of Vintula (C. I. No. 1241) was grown in 1921 to sow approximately 10,000 acres.

The culms of the Vintula variety are medium in size, green, and usually number seven to the plant. Their average height, including the panicles, is 51 inches. The culm and sheath nodes are green. The auricles are conspicuous and deciduous. The ligules average five-eighths of an inch in length. The leaf blades are broad, averaging half an inch in width. The panicles, which are more or less open, have an average length of 10 inches, and each bears on an average 145 seeds.

The seeds (Pl. III, *A* and *B*) average 9.6 millimeters in length and 3.1 millimeters in thickness. The glumes are pale yellow and have smooth margins. The hull loosely incloses the kernel, is thin, and sparingly covered with short white hairs. The apex of the hull terminates in two conical light-yellow teeth. These are located on the meson, are unequal in length, and slightly bent ventrad. The conical lateral teeth usually are absent and when present are inconspicuous.

The kernels (Pl. III, *C* and *D*) average in length 7.2 millimeters, in width 1.8 millimeters, and in thickness 2.6 millimeters. Viewed laterally, their dorsal and ventral margins are unequally convex, the ventral being the less so. Their distal ends are obtuse, but sharply curved toward the ventral margin. The opaque area is never prominent and when present is narrow and located on or near the dorsal margin.

This variety matures in approximately 123 days and has produced an average acre yield of 2,086 pounds of paddy and 1,149 pounds of straw. It has yielded slightly over 2,000 pounds of grain per acre on the lighter prairie soils of southwestern Louisiana and has averaged about 4,000 pounds per acre on the Delta lands of the Mississippi River section of the State.

### SALVO.

The Salvo is a pure-line selection from the Djember variety, which was obtained by the United States Department of Agriculture in 1904 from Charles A. Franc, Soerabaya, Java.

The selection was made at the Rice Experiment Station, Crowley, La., by the writers in 1911. The name Salvo is derived from the Latin, meaning safe, and was applied to this selection in 1917. The selection was increased from nursery to plat experiments in 1914. The plat yields are given in Table 2. The variety was distributed in southwestern Louisiana for commercial growing in 1918. The acreage of Salvo (C. I. No. 1297) is not definitely known, as at present it is grown only for home use.

The stout culms of this variety are green and usually number six to the plant. Their average height, including the panicles, is 51 inches. The culm nodes are green, marked with brown; the sheath nodes are light green. The auricles are conspicuous and persistent. The ligules average three-fourths of an inch in length. The leaf blades are broad, averaging three-fourths of an inch in width. The panicles have an average length of 10½ inches, and each bears on an average 143 seeds.

The seeds (Pl. III, *E* and *F*) average 10.3 millimeters in length and 3.1 millimeter in thickness. The glumes are brown and have smooth margins. The hull, which loosely incloses the kernel, is light yellow and medium in thickness. Its surface is thickly covered with short white hairs, which obscure in part its burlaplike appearance. The apex of the hull terminates in two conical purple teeth, which are located on the meson. These are unequal in length and bent ventrad. The conical lateral teeth are usually absent and when present are very inconspicuous.

The kernels (Pl. III, *G* and *H*) average in length 7.7 millimeters, in width 1.9 millimeters, and in thickness 2.4 millimeters. Viewed laterally, the dorsal and ventral margins are unequally convex, the ventral margin being the less so. The distal end is obtuse and slightly curved toward the ventral margin. The opaque area is narrow and located near the center.

This variety matures in approximately 144 days and has produced an average acre yield of 1,774 pounds of paddy and 1,790 pounds of straw. It seems to be well adapted to the lighter soils of southwestern Louisiana. Salvo, like Delitus, has a pop-cornlike flavor.

### HONDURAS.

The name Honduras was applied to a long-grain rice that was imported from Honduras into Louisiana through commercial sources, probably as early as 1890. On account of its productiveness it soon supplanted the Carolina varieties on the Delta lands of the State and later was introduced into southwestern Louisiana, where it was the leading variety as long as new land was available for rice culture. It probably is a strain of the Creole variety, which is extensively grown in Morelos, Mexico.

The very stout green culms of the Honduras variety usually number five to the plant. Their average height, including the panicles, is 54 inches. The culm nodes are dark green; sheath nodes light green. The auricles are deciduous. The ligules are three-fourths of

an inch long. The leaf blades are broad, averaging five-eighths of an inch in width. The panicles (Fig. 3) have an average length of 9¾ inches, and each bears on an average 157 seeds.

The seeds (Pl. III, *I* and *J*) average 10 millimeters in length and 3.4 millimeters in thickness. The glumes are pale yellow and have smooth margins. The hull loosely incloses the kernel, is light yellow, and medium in thickness. Its surface has a burlaplike appearance and is thinly and evenly covered with white hairs. The apex of the hull terminates in four conical light-yellow teeth. The two that are prominent are located on the meson, the dorsal one being the longer and sometimes spinelike. This conical tooth may develop into an awn when the variety is grown on very rich soil. The other two are lateral and small.

The kernels (Pl. III, *K* and *L*) average in length 8 millimeters, in width 1.9 millimeters, and in thickness 2.8 millimeters. Viewed laterally, the dorsal and ventral margins are equally convex, and the distal end is obtuse. The opaque area, when present, is usually located on or near the dorsal margin.

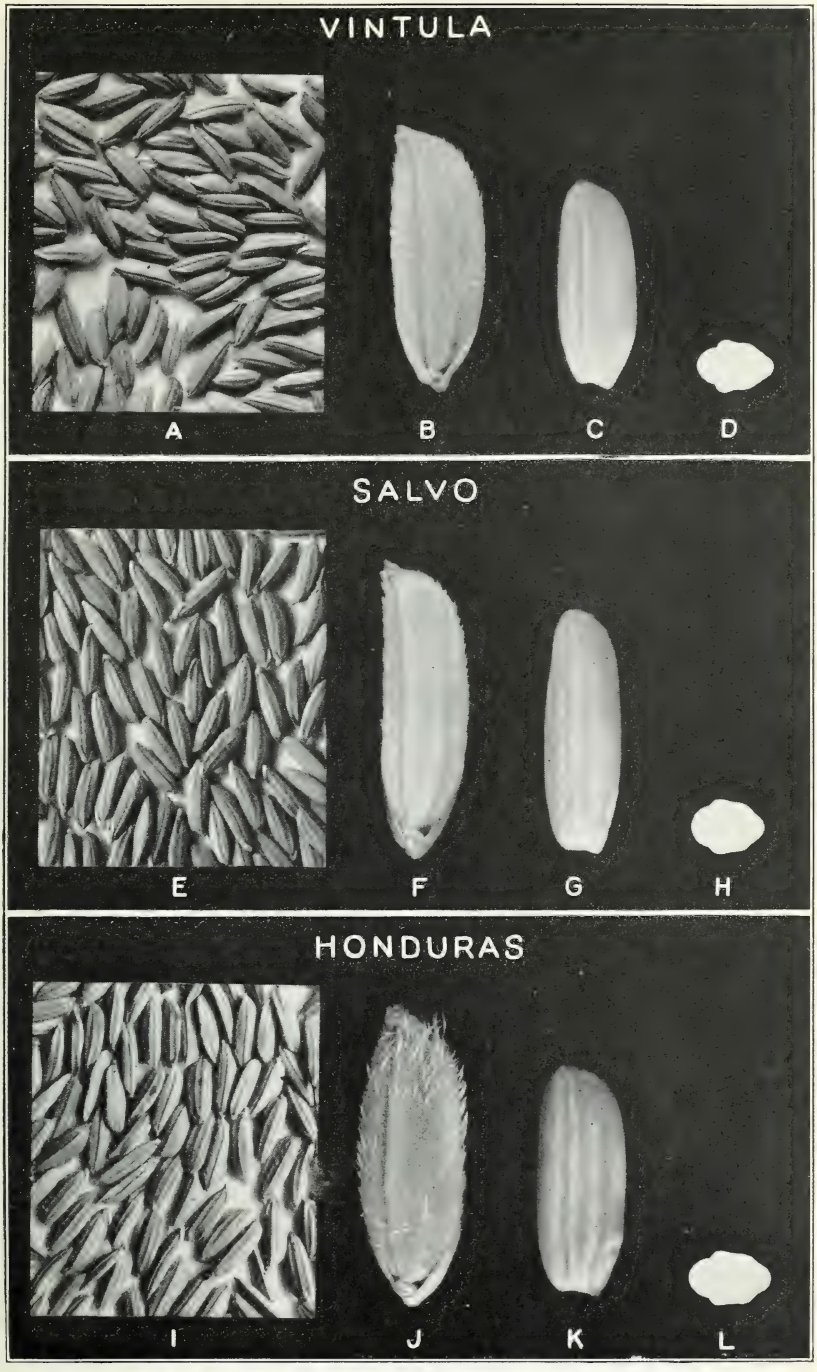
This variety matures in approximately 123 days and has produced an average acre yield of 1,834 pounds of paddy and 2,363 pounds of straw. It is the principal long-grain rice grown in Louisiana, Texas, and Arkansas. It has yielded at the rate of 1,914 pounds of paddy per acre on the Delta lands of the Mississippi River in Louisiana and as high as 2,045 pounds of paddy on new prairie lands in Arkansas. When grown on land that has been cropped too heavily to rice, it produces low yields of paddy, often too inferior in quality to make a good milled product. Because of its lack of productiveness on the poorer lands, the acreage of Honduras rice has been greatly reduced in southwestern Louisiana. In the Mississippi and Teche River sections of Louisiana this variety produces its maximum yields and should be grown there on a larger acreage.

The milled product of this rice always has a ready market. Its popularity is due to the fact that the kernels do not form a pastelike mass when boiled. These properties are highly valued by those who eat rice regularly. This class of consumers also uses the broken as well as the whole kernels of this variety, which indicates rather strongly that something more is necessary than a whole kernel (head rice) to make an attractive and palatable dish of rice.

#### WATARIBUNE.

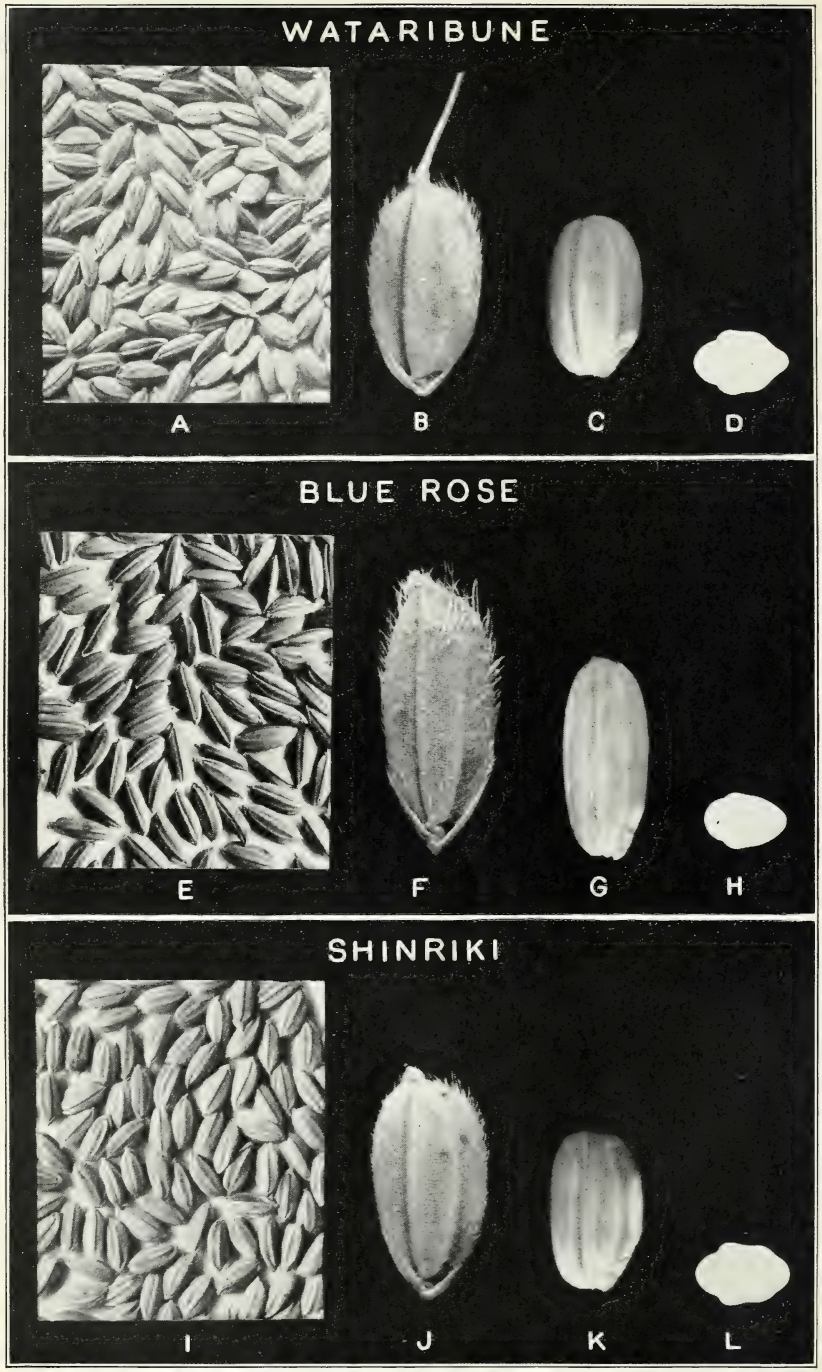
The Wataribune variety was grown for the first time in this country at Webster, Tex., in 1908, by S. Sabaira, a Japanese farmer, who imported the seed from Japan. The seed from this crop was sold by J. A. Lambert, Houston, Tex., under the name "Watari." Although a rice of high-yielding capacity and excellent quality, it has never been grown extensively in Louisiana, Texas, and Arkansas. Wataribune and selections from it are the principal varieties cultivated in California.

The rather thick culms of this variety are light green, streaked with dark green, and usually number eight to the plant. Their average height, including the panicles, is 43 inches. The culm nodes




SEEDS AND KERNELS OF RICE OF THE VINTULA, SALVO, AND HONDURAS VARIETIES.

*A, B, E, F, I, J,* Seeds; *C, G, K,* kernels; *D, H, L,* transverse sections of kernels. (Figures *A, E,* and *I,* natural size; all others, × 4),




SEEDS AND KERNELS OF RICE OF THE WATARIBUNE, BLUE ROSE, AND SHINRIKI VARIETIES.

*A*, *B*, *E*, *F*, *I*, *J*, Seeds; *C*, *G*, *K*, kernels; *D*, *H*, *L*, transverse sections of kernels. (Figures *A*, *E*, and *I*, natural size; all others, × 4.)

are dark green streaked with light green, the sheath nodes light green. The auricles are persistent. The ligules are five-eighths of an inch in length. The leaf blades are narrow, averaging three-eighths of an inch in width. The panicles have an average length of 8¾ inches, and each bears on an average 137 seeds.

The seeds (Pl. IV, *A* and *B*) average 7.4 millimeters in length and 3.7 millimeters in thickness. The glumes are pale yellow and have smooth margins. The hull, which loosely incloses the kernel, is light yellow and medium in thickness. Its surface has a burlaplike appearance and is thinly covered with white hairs. These hairs are longer and more conspicuous toward the apex and are usually prominent on the veins. A light-yellow awn with a very short conical yellow tooth at its base on each side is characteristic of the variety. The awn varies in length from 10 to 26 millimeters, is deciduous, and sometimes not present on all spikelets of the panicle. When the awn is absent, the apex of the hull terminates in four conical yellow teeth. The two that are prominent are located on the meson and are unequal in length, the longer one lying dorsally. The other two are lateral and rather short.

The kernels (Pl. IV, *C* and *D*) average in length 5.5 millimeters, in width 2.1 millimeters, and in thickness 3.2 millimeters. Viewed laterally, their dorsal and ventral margins are equally convex, and their distal end is broadly obtuse. The opaque area when present is small and is located on or near the dorsal margin.

This variety matures in approximately 137 days and has produced an average acre yield of 2,727 pounds of paddy and 1,777 pounds of straw. It may be grown on the poorer prairie lands of Louisiana and Texas with more profit than may be obtained from Blue Rose, which has a longer period of growth and requires richer soil for high production. Wataribune rice should not be sown on very rich soil, for under such conditions it shows a tendency to lodge.

### BLUE ROSE.

The Blue Rose variety is the result of a selection made by Sol. Wright, of Crowley, La., from an unknown variety which was found by J. F. Shoemaker, also of Crowley, La., in 1907, in a field of a Japanese rice that he was growing east of Jennings, La., near the Mermentau River. Many plants of this unknown variety were cut at maturity by Mr. Shoemaker and given by him to Mr. Wright, who isolated a strain which he later offered for sale under the name Blue Rose.

The stout light-green culms of this variety are striped with dark green and usually number seven to the plant. Their average height, including the panicles, is 44 inches. The culm nodes are dark green; sheath nodes light green. The auricles are deciduous. The ligules are half an inch long. The leaf blades are broad, averaging five-eighths of an inch in width. The panicles have an average length of 8½ inches, and each bears, on an average, 144 seeds.

The seeds (Pl. IV, *E* and *F*) average 8.7 millimeters in length and 3.4 millimeters in thickness. The glumes are pale yellow and have smooth margins. The hull loosely incloses the kernel and is yellow and thick. Its surface has a burlaplike appearance and is thinly

covered with long white hairs which are longer and more numerous toward the apex. The apex of the hull terminates in four conical pale-yellow teeth. The two prominent ones are located on the meson, are unequal in length, and are slightly bent ventrad. The other two are lateral and very short.

The kernels (Pl. IV, *G* and *H*) average in length 6.6 millimeters, in width 1.9 millimeters, and in thickness 2.8 millimeters. Viewed laterally, the dorsal and ventral margins are equally convex, and the distal end is obtuse. The opaque area when present is small and located on or near the dorsal margin.

This variety matures in approximately 148 days and has produced an average acre yield of 2,086 pounds of paddy and 2,520 pounds of straw. Although it has the longest growing period of any of the varieties cultivated in this country, Blue Rose is preferred in the Southern States to the more productive Japanese varieties because of the general similarity of its kernels to those of the Honduras variety, which is so widely known and valued as a rice of excellent cooking quality. It lacks, however, the culinary properties of Honduras rice, but it produces a larger yield of head rice, upon which, unfortunately, the miller has placed too high a premium. Large mill yields are important, and varieties that can produce them are desirable, but a rice must also possess certain qualities for table use before it can become a highly marketable product for the occasional as well as the daily consumer.

### SHINRIKI.

The principal introduction of the Shinriki variety was made from Japan in 1902 by Dr. S. A. Knapp, then an agricultural explorer of the United States Department of Agriculture. Prior to 1910 Shinriki was probably the best known of the Japanese varieties grown in Louisiana and Texas.

The slender wiry culms of this variety are light green and usually number 13 to the plant. Their average height, including the panicles, is 37 inches. The culm and sheath nodes are light green. The auricles are deciduous. The ligules are half an inch long. The leaf blades are very narrow, averaging three-eighths of an inch in width. The panicles have an average length of 8 inches, and each bears on an average 105 seeds.

The seeds (Pl. IV, *I* and *J*) average 7.3 millimeters in length and 3.6 millimeters in thickness. The glumes are pale yellow and have smooth margins. The hull, which loosely incloses the kernel, is light yellow and medium in thickness. Its surface has a burlaplike appearance and is thinly covered with short white hairs, which are longer and more conspicuous toward the apex. The apex of the hull terminates in four conical light-green teeth. The two prominent ones are located on the meson and are unequal in length. The other two are lateral and very short.

The kernels (Pl. IV, *K* and *L*) average in length 5.4 millimeters, in width 2.1 millimeters, and in thickness 3.1 millimeters. Viewed laterally, the dorsal and ventral margins are equally convex, and the distal end is broadly obtuse. The opaque area is seldom conspicuous and when present is located on the dorsal margin.

This variety matures in approximately 143 days and has produced an average acre yield of 2,500 pounds of paddy and 1,734 pounds of straw. It is not grown on a large acreage in the United States, mainly because its culms are too short to be cut with a binder without the loss of some grain, even when the plants produce a normal yield. This loss, of course, does not occur in Japan, where the variety is extensively grown, because the crop is cut with hand hooks. The Shinriki and Wataribune varieties are usually quoted as "Japan rice" in the southern rice markets of the United States.

## COMPARISON OF VARIETIES.

The stems and foliage of the varieties described, except Delitus, Evangeline, Vintula, and Honduras, retain their green color after the grain ripens. Usually the entire plant of these four varieties matures rapidly, the leaves turning yellow as the grain ripens.

Uniformity in the size of the seed is strikingly characteristic of the Fortuna, Acadia, Delitus, Tokalon, Wataribune, and Shinriki varieties. The seeds on the lower part of the panicles of Evangeline and Honduras often vary in size. When grown on poor soil, Evangeline, Honduras, and Blue Rose often produce stunted panicles, bearing imperfect seeds. The dimensions of the seeds of all varieties are shown in Table 1.

None of these varieties shows complete resistance to the fungous disease (rotten-neck) caused by *Piricularia oryzae* Br. and Cav. Honduras is very susceptible, and all of them may be seriously affected by this disease if they are left uncut too long after maturity. The conditions which produce the straighthead disease have no effect upon Fortuna and Vintula, as so far observed.

TABLE 1.—*Average dimensions of seeds and kernels of seven new and four long-established varieties of rice grown at the Rice Experiment Station, Crowley, La.*

[Thickness=dorsiventral diameter; width=lateral diameter.]

| Class and variety. | C. I. No. | Dimensions (millimeters). | | | | | |
|---|---|---|---|---|---|---|---|
| | | Seeds (spikelets). | | | Kernels. | | |
| | | Length. | Thickness. | Width. | Length. | Thickness. | Width. |
| Long-grain varieties: | | | | | | | |
| Fortuna | 1344 | 10.1 | 3.1 | 2.1 | 7.7 | 2.5 | 1.8 |
| Delitus | 1206 | 8.9 | 2.9 | 2.0 | 7.1 | 2.4 | 1.6 |
| Tokalon | 51 | 9.3 | 2.9 | 2.1 | 7.5 | 2.4 | 1.8 |
| Evangeline | 1162 | 9.0 | 3.1 | 2.1 | 7.0 | 2.6 | 1.8 |
| Vintula | 1241 | 9.6 | 3.1 | 2.0 | 7.2 | 2.6 | 1.8 |
| Salvo | 1297 | 10.3 | 3.1 | 2.1 | 7.7 | 2.4 | 1.9 |
| Honduras | 1643 | 10.0 | 3.4 | 2.3 | 8.0 | 2.8 | 1.9 |
| Medium-grain variety: | | | | | | | |
| Blue Rose | 1962 | 8.7 | 3.4 | 2.1 | 6.6 | 2.8 | 1.9 |
| Short-grain varieties: | | | | | | | |
| Acadia | 1988 | 7.2 | 3.7 | 2.5 | 5.7 | 3.2 | 2.1 |
| Wataribune | 1561 | 7.4 | 3.7 | 2.5 | 5.5 | 3.2 | 2.1 |
| Shinriki | 1642 | 7.3 | 3.6 | 2.3 | 5.4 | 3.1 | 2.1 |

Losses from shattering may be greatly lessened by the prompt harvesting of varieties that are known to thrash easily and by the early

seeding of varieties which have a long growing period. The long-grain varieties, which are late in maturing, show a greater tendency to shatter their grain than the short-grain rices that ripen at the same time. The early-maturing varieties, which as a rule have long grains, seldom shatter unless left standing too long after the irrigation water has been drained from the field. When maturity occurs in late autumn there always is greater shattering, regardless of the variety of rice. The agronomic characters, including yield, of the 11 varieties here described are given in Table 2.

TABLE 2.—*Average agronomic data and annual and average yields of seven new and four long-established varieties of rice grown on tenth-acre plats at the Rice Experiment Station, Crowley, La., during periods of varying length in the 9-year period from 1913 to 1921, inclusive.*

AVERAGE AGRONOMIC DATA.

| Class and variety. | C. I. No. | Date of— | | | | | Time to maturity (days) from— | | Days of submergence. |
|---|---|---|---|---|---|---|---|---|---|
| | | Seeding. | Emergence. | Submergence. | First heading. | Maturity. | Seeding. | First heading. | |
| Long-grain varieties: | | *May* | *May* | *June* | *Aug.* | *Sept.* | | | |
| Fortuna | 1344 | 2 | 17 | 17 | 20 | 21 | 142 | 32 | 96 |
| Delitus | 1206 | 4 | 19 | 15 | 7 | 12 | 131 | 36 | 89 |
| Tokalon | 51 | 3 | 17 | 17 | 23 | 23 | 143 | 31 | 98 |
| Evangeline | 1162 | 3 | 17 | 18 | 3 | 2 | 122 | 30 | 76 |
| Vintula | 1241 | 2 | 17 | 15 | 3 | 2 | 123 | 30 | 79 |
| Salvo | 1297 | 3 | 18 | 17 | 21 | 24 | 144 | 34 | 99 |
| Honduras | 1643 | 3 | 17 | 16 | 3 | 3 | 123 | 31 | 79 |
| Medium-grain variety: | | | | | | | | | |
| Blue Rose | 1962 | 1 | 19 | 19 | 26 | 26 | 148 | 31 | 99 |
| Short-grain varieties: | | | | | | | | | |
| Acadia | 1988 | 3 | 17 | 18 | 16 | 19 | 139 | 34 | 93 |
| Wataribune | 1561 | 3 | 18 | 16 | 14 | 17 | 137 | 34 | 93 |
| Shinriki | 1642 | 3 | 20 | 17 | 19 | 23 | 143 | 34 | 98 |

| Class and variety. | Culms per plant. | Dimensions (inches). | | | Seeds per panicle. | Weight of product (pounds). | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Height of plant at— | | Length of panicle. | | Acre yield. | | Per bushel. | Hulls in 100 pounds of paddy. |
| | | Date of submergence. | Maturity.[1] | | | Grain. | Straw. | | |
| Long-grain varieties: | | | | | | | | | |
| Fortuna | 5 | 13.4 | 51 | 11.50 | 187 | 2,530 | 2,210 | 43 | 21.0 |
| Delitus | 7 | 11.9 | 53 | 9.70 | 122 | 1,862 | 1,350 | 43 | 22.0 |
| Tokalon | 6 | 14.3 | 50 | 10.35 | 152 | 2,443 | 2,310 | 44 | 18.2 |
| Evangeline | 6 | 13.3 | 45 | 8.50 | 140 | 2,027 | 1,191 | 44 | 21.6 |
| Vintula | 7 | 12.9 | 51 | 10.00 | 145 | 2,086 | 1,149 | 42 | 20.6 |
| Salvo | 6 | 11.9 | 51 | 10.50 | 143 | 1,774 | 1,790 | 41 | 22.0 |
| Honduras | 5 | 15.5 | 54 | 9.75 | 157 | 1,834 | 2,363 | 41 | 20.6 |
| Medium-grain variety: | | | | | | | | | |
| Blue Rose | 7 | 14.5 | 44 | 8.50 | 144 | 2,086 | 2,520 | 44 | 20.6 |
| Short-grain varieties: | | | | | | | | | |
| Acadia | 10 | 12.3 | 50 | 8.98 | 132 | 2,884 | 2,020 | 44 | 17.2 |
| Wataribune | 8 | 10.6 | 43 | 8.65 | 137 | 2,727 | 1,777 | 44 | 18.0 |
| Shinriki | 13 | 8.8 | 37 | 8.00 | 105 | 2,500 | 1,734 | 46 | 19.0 |

[1] Including panicle

ANNUAL AND AVERAGE YIELDS.

Yields per acre, pounds.]

| Class and variety. | Annual. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 |
| Long-grain varieties: | | | | | | | | | |
| Fortuna | | | 1,590 | 2,730 | 3,420 | 3,020 | 2,750 | 1,900 | 2,300 |
| Delitus | | 2,100 | 1,980 | 2,010 | 1,255 | 1,840 | 1,710 | 1,220 | 2,780 |
| Tokalon | | | 2,555 | 2,350 | 2,870 | 2,550 | 2,680 | 2,050 | 2,050 |
| Evangeline | | 1,660 | 2,650 | 1,890 | 1,798 | 2,010 | 2,530 | 1,430 | 2,250 |
| Vintula | | 2,800 | 2,240 | 2,085 | 1,457 | 2,070 | 2,150 | 1,310 | 2,590 |
| Salvo | | 2,610 | 1,500 | 2,130 | 1,760 | 2,060 | 1,590 | 1,150 | 1,390 |
| Honduras | 1,850 | 1,500 | 1,900 | 2,230 | 1,920 | 2,000 | 1,470 | 1,900 | 1,740 |
| Medium-grain variety: | | | | | | | | | |
| Blue Rose | | | 1,888 | | 3,130 | 2,770 | 1,690 | 1,290 | 1,750 |
| Short-grain varieties: | | | | | | | | | |
| Acadia | | | | 3,665 | 3,610 | 2,910 | 2,620 | 2,170 | 2,330 |
| Wataribune | 2,570 | 2,180 | 2,833 | 3,530 | 1,894 | 3,380 | 3,080 | 3,240 | 1,830 |
| Shinriki | 2,700 | 2,180 | 2,500 | 2,590 | 2,362 | 2,980 | 1,900 | 2,960 | 2,330 |

| Class and variety. | Average for years stated, dates inclusive. | | | | | |
|---|---|---|---|---|---|---|
| | 5 years, 1917 to 1921. | 6 years, 1916 to 1921. | 6 years, 1915 and 1917 to 1921. | 7 years, 1915 to 1921. | 8 years, 1914 to 1921. | 9 years, 1913 to 1921. |
| Long-grain varieties: | | | | | | |
| Fortuna | 2,678 | 2,687 | 2,497 | 2,530 | | |
| Delitus | 1,761 | 1,803 | 1,798 | 1,828 | 1,862 | |
| Tokalon | 2,440 | 2,425 | 2,459 | 2,443 | | |
| Evangeline | 2,004 | 1,985 | 2,111 | 2,080 | 2,027 | |
| Vintula | 1,913 | 1,942 | 1,968 | 1,985 | 2,086 | |
| Salvo | 1,590 | 1,680 | 1,575 | 1,654 | 1,774 | |
| Honduras | 1,806 | 1,877 | 1,822 | 1,880 | 1,833 | 1,834 |
| Medium-grain variety: | | | | | | |
| Blue Rose | 2,126 | | 2,086 | | | |
| Short-grain varieties: | | | | | | |
| Acadia | 2,728 | 2,884 | | | | |
| Wataribune | 2,687 | 2,827 | 2,711 | 2,828 | 2,747 | 2,727 |
| Shinriki | 2,506 | 2,520 | 2,505 | 2,517 | 2,475 | 2,500 |

The grain of the Acadia, Wataribune, Blue Rose, and Shinriki varieties is not easily removed from the straw. Unless the separator is fed very slowly when these varieties are thrashed, there is considerable loss of grain. Similar care must be exercised for another reason in thrashing Honduras and Evangeline. Their straw becomes very brittle after drying in the shock and is not easily separated from the grain when the thrasher is fed too rapidly.

The culinary properties of the new varieties described in this bulletin have a commercial value, and if properly exploited by the trade they should greatly increase the demand for rice as a daily article of food. The rice-eating people of this country, like the orientals, eat this cereal mainly in the boiled state and show a preference for those varieties whose kernels retain their general shape and remain separate when prepared in this way. These varieties possess this characteristic and for this reason should be more marketable than those which form a pastelike mass when boiled.

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